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## ROCKY MOUNTAIN SPOTTED (OR TICK) FEVER.

SHEEP GRAZING AS A POSSIBLE MEANS OF CONTROLLING THE WOOD TICK (*DERMACENTOR ANDERSONI*) IN THE BITTER ROOT VALLEY.

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Since the discovery that Rocky Mountain spotted fever is transmitted by the bite of the wood tick, *Dermacentor andersoni*, different measures have been proposed for the eradication of the ticks.

These measures are as follows:

1. Clearing and cultivation of tillable land.
2. Burning over of foothills and "slashings."
3. Killing of the small wild mammals.
4. Dipping of domestic animals in arsenical dip.
5. Spraying and removing ticks by hand from domestic animals.

Each one of these measures has a rational basis in the bionomics of the tick *Dermacentor*, and it is possible that any one of them if judiciously employed over a suitable and limited territory might eventually eliminate the tick infestation. Yet all of these methods have been attempted on the west side of the Bitter Root Valley for three years or more without greatly diminishing the number of ticks to be found or the number of deaths from spotted fever. The total number of deaths reported this year (6) is only very little less than that reported for 1903, 10 years ago (9).

The extent and inaccessibility of the infested territory and the consequent expense have rendered the problem difficult. The territory considered extremely dangerous because it harbors, for some as yet unknown reason, a particularly virulent strain of spotted fever, and over which the tick *Dermacentor andersoni* is generally though not uniformly distributed, is 100 miles long by approximately 10 miles wide. It lies on the west side of the Bitter Root River, includes the foothills and eastern slopes of the Bitter Root Mountains, and contains some of the wildest and roughest country within the boundaries of the United States.

Without doubt certain areas west of the river have been entirely freed of ticks and rendered safe for habitation by clearing and cultivating within the past few years, and as this work of clearing and planting continues with the increased demand for tillable land in

the valley it is not unreasonable to expect that within a few years all the arable land on the west side of the river will be under cultivation and free from ticks; but the greater part by far of the land west of the Bitter Root River is incapable of cultivation, and the question is whether the danger will not still lurk just over the fence after the tillable land is all under cultivation.

Burning has been both preached and sporadically practiced in the valley. Unless judiciously employed, however, it is likely to do great damage to the forests, and at the same time do more harm than good toward eradicating the ticks. The burning should be under the supervision of the Forest Service. It is applicable only along the foothills and among the slashings late in the spring, and once begun the territory should be burned over regularly each year following in order to prevent the growth of a tick environment even more favorable than previously existed.

During the seasons of 1911 and 1912 McClintic destroyed, at considerable expense, practically all the small wild mammals over a territory of 8 square miles west of Victor. This was only a patch on the total area infested, and because the work of extermination could not be continued this season the small animals are rapidly reoccupying their old haunts.

Since these small mammals serve as hosts for the larval and nymphal forms of the ticks, the farmers should be instructed as to the best means of destroying them and encouraged in keeping their farms free from these pests.

It has been claimed that by the dipping and hand treating alone of domestic animals the ticks could be eradicated from the valley within three years, and it would then only be necessary to avoid reinfestation by the incoming of cattle from other places.<sup>1</sup>

McClintic<sup>2</sup> first pointed out the undue optimism of this statement, and further observations made around the Victor dipping vat, which has now been in operation for three successive seasons, support his views.

The adult ticks feed and the females are fertilized almost entirely upon the large mammals, domestic and wild, and unquestionably where horses and cattle are allowed to range over tick-infested territory they will perpetuate the infestation unless measures are taken to destroy the ticks which they acquire.

Where the horses and cattle so allowed to range are numerous periodical dipping during the tick season is the most feasible method known for the destruction of the ticks carried by them, and if continued over the west side of the Bitter Root Valley, as now contemplated, with a dipping vat every 10 miles, it will undoubtedly

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<sup>1</sup> Hunter, W. D., and Bishopp, F. C., Bulletin No. 105, U. S. Department of Agriculture, Washington, 1911.

<sup>2</sup> Public Health Reports, Vol. XXVII, No. 20, May 17, 1912.

greatly reduce the tick infestation in the vicinity of the farms and ranches. That it will entirely eradicate the ticks and solve the spotted-fever problem is extremely improbable.

This season an estimated tick infestation of from 3,520 to 7,040 per square mile was found 2 miles up the eastern slopes of the Bitter Root Mountains, where no domestic animals had ranged for 4 years or more, while above this, among the so-called "goat rocks," the number of ticks per square mile was so great it could hardly be estimated. They were found clinging to almost every grass blade, and must have amounted to millions.

It seems incredible that the dipping of domestic animals in the valley can affect this infestation in the mountains, while it is not improbable that the progeny of these ticks in one stage or another may be carried into the valley from time to time by wild animals.

Perhaps the quickest way to reach these ticks would be to encourage the killing of the large wild animals in the mountains, particularly the mountain goats and the bears. The latter are by no means uncommon, and range from the goat rocks down into the foothills in early summer, just in time to drop their engorged ticks.

There are many thousand domestic animals in the Bitter Root Valley, but only a very small percentage of them are found on tick-infested territory during any one tick season. In fact, the actual number of animals grazing over certain infested districts in the valley is at present so small that it would be cheaper to prohibit such grazing entirely than to construct and operate dipping vats in those districts.

In studying these various spotted-fever problems in the Bitter Root Valley and the difficulties attending the different measures proposed for tick eradication, the possibility of finding some less expensive method by means of which a general offensive campaign might be carried into the mountains was carefully considered at the beginning of this season's work. With this end in view, an investigation of sheep grazing in the valley was begun, and on May 4 a band of 61 sheep was obtained for experimental purposes.

Sheep raising has been a considerable industry on the east side of the Bitter Root Valley since 1890. This was good sheep country, and at one time between 50,000 and 60,000 sheep ranged over the low foothills and back into the forests on the east side. With the reclamation of these dry foothills, which began several years ago, the number of sheep has decreased until there are now less than 20,000. Except for a few scattered bands of a few hundred sheep, no sheep grazing has been done on the west side of the Bitter Root Valley. It is commonly reported that ticks were abundant over the entire east side of the valley 25 years ago before the sheep grazing began, and ticks are still found on the east side where cattle are

permitted to range, but in a recent survey of Willow Creek Canyon and Sleeping Child Canyon, where sheep have been continuously grazed, no ticks were found. It might be claimed that the simple exclusion of cattle from a sheep range is sufficient in itself to eradicate the ticks, but no cattle have ever ranged in parts of the Bitter Root Mountains where the ticks are nevertheless abundant.

#### Sheep Experiments.

On May 4, 61 sheep free from ticks were obtained and driven into the tick-infested country  $3\frac{1}{2}$  miles southwest of Victor. The sheep were divided into two bands. The one containing 51 sheep was allowed to graze at liberty over the tick-infested hills in care of a herder, while the remaining 10 sheep were placed in a 5-acre pasture apparently free from ticks, and were used by having ticks placed upon them at different times. It is possible that the pasture may have contained a very few ticks, though none were found after careful dragging, and hence it is believed that the number could not have been great enough to influence the experiments in any way.

Owing to a lack of funds, it was impossible to have constructed suitable stalls where all the ticks so used could be accounted for, but, on the other hand, after the ticks had been placed in their wool, the sheep were grazing under practically normal conditions.

#### EXPERIMENT NO. 1.

*Unengorged ticks placed in sheep's wool May 7; dead ticks recovered May 9.*

	Number of unengorged ticks placed.	Number of dead ticks recovered.
Sheep No. 1.....	10	8
Sheep No. 2.....	10	9
Sheep No. 3.....	10	9
Sheep No. 4.....	10	8
Sheep No. 5.....	10	9
Sheep No. 6.....	10	9
Sheep No. 7.....	10	9
Total.....	70	61

#### EXPERIMENT NO. 2.

*Unengorged ticks placed in sheep's wool May 9; dead ticks recovered May 10.*

	Number of unengorged ticks placed.	Number of dead ticks recovered.
Sheep No. 4.....	10	8
Sheep No. 5.....	10	8
Sheep No. 6 <sup>1</sup> .....	10	8
Sheep No. 7.....	10	9
Sheep No. 8.....	10	9
Sheep No. 9.....	10	8
Sheep No. 10.....	25	24
Total.....	85	74

<sup>1</sup> One live tick found May 10 crawling on outside of wool. It could not be determined whether this was one of the ticks placed on sheep or one acquired just previous to examination.

## EXPERIMENT NO. 3.

*Unengorged ticks removed from horses at vat and placed in wool on sheep May 19; dead ticks recovered May 21.*

	Number of unengorged ticks placed.	Number of dead ticks recovered.
Sheep No. 1.....	20	15
Sheep No. 2.....	20	15
Sheep No. 3.....	20	29
Sheep No. 4.....	20	19
Sheep No. 5.....	20	19
Sheep No. 6.....	20	20
Sheep No. 7.....	20	15
Total.....	140	123

One female tick was found firmly attached on No. 1 sheep and one on No. 2. These were the only ticks found firmly attached in this series of experiments; one tick was found alive (experiment No. 2), but unattached. It may not have been one of the ticks employed. All the other ticks found were dead, but not all of the ticks planted were found. They may have been overlooked, and if so probably were dead, as the live ticks are much more easily found; or they may have crawled off the sheep alive, or they may have died and dropped out of the wool. It is believed that in the case of sheep No. 7, experiment 3, some ticks were lost in the last way, as this sheep escaped from the pen just before it was examined and was caught only after a long chase around the pasture.

These experiments show that over 87 per cent of the ticks placed in the wool of the sheep along their backs and flanks died within 48 hours. The ultimate fate of the remaining ticks is uncertain, but they certainly were not engorged and fertilized on the sheep.

## EXPERIMENT NO. 4.

On May 13, nine days after the band of 51 sheep was started on the range, the sheep were examined for ticks, and the ticks removed as follows:

Dead ticks.....	44
Live, unengorged ticks.....	53
Live, slightly engorged ticks.....	15
Live, one-half to two-thirds engorged ticks.....	24

It is believed that if this search had been postponed a week longer the proportion of live to dead ticks found would have been much less. The unengorged ticks were found crawling on the sheep's wool and attached around their ears. It is probable that some of the former were collected by the sheep only a few hours before the examination was made.

The engorged ticks were much easier found than the dead ones, and were generally attached around the sheep's ears. The majority of the ticks were not firmly attached, and in only one case were the male and female found in approximation.

Forty-five of the unengorged ticks and 11 of the slightly engorged ticks died within 36 hours after removal, although they were kept in moist, well-ventilated boxes.

#### EXPERIMENT NO. 5.

It having been found that the great majority of ticks attach themselves around the ears on the sheep, a simple method of preventing this was considered. From 2 to 3 ounces of crude oil was applied around the ears of 20 sheep on May 21, and no ticks were afterwards found attached to these sheep around the ears.

#### Ticks on Freely Grazing Sheep.

On May 28, 15 days after last examination, 36 sheep which had been freely grazing over tick-infested territory were searched and the following ticks removed:

Dead.....	131
Live females up to one-third engorged.....	13
Live females one-half to fully engorged.....	6
Live males engorged.....	12

Twelve one-half to fully engorged females were found dead and shrunk, but still entangled in the wool of the sheep.

On May 31 the sheep were sheared and again turned out on the range. On June 10 they were again searched for ticks, and on the 61 sheep the following ticks were found:

Dead, females.....	5
Live, females, engorged.....	3
Live females, partly engorged.....	2

No male ticks were found. It is possible that the dead ticks may have been on the sheep at the time they were sheared.

On June 11 the band of freely grazing sheep was increased to 154 by the addition of other sheep which had been recently sheared and were known to be free from ticks. The entire band was grazed over tick-infested country until June 26, when 150 of them were searched. The following table shows the number of ticks removed:

Dead.....	33
Live, engorged.....	20
Live, partly engorged.....	16
Live, males.....	5

The relatively small number of ticks found after the sheep had been sheared and the fact that only an occasional engorged tick and no dead ones were found on the lambs make it seem probable that the majority of the ticks leave the sheep when the wool is short enough to permit them to do so.

The sheep used in these experiments were crossbred, and until they were sheared were infested with the so-called "sheep tick," *Melophagus ovinus*.

Since it appeared that the males experienced considerable difficulty in propelling themselves through the thick wool in search of the females, the engorged females have been kept in order to determine what proportion of them had been fertilized.

#### Summary.

1. Over 87 per cent of 295 ticks placed in the wool of unshorn sheep were recovered dead.

2. The majority of the ticks recovered from sheep grazing naturally over tick-infested territory were found dead.

3. Many of the engorged females recovered appeared not to have been fertilized.

4. Comparatively few ticks, either alive or dead, were found on the sheep after they had been sheared.

It is believed that these findings warrant the continuation of the experiment by the placing of a band of 2,000 wethers on some selected range west of the Bitter Root River as early in the spring as possible. The selected range should be closely grazed until shearing time, and then, if desired, the sheep could be sheared, dipped, and transferred to the east side of the valley without danger of carrying wood ticks, or returned immediately to the range until the experiment is completed.

Four factors are to be considered in the sheep-grazing experiments:

First. The removal of undergrowth and the consequent destruction of "good tick country" by close grazing.

Second. The destruction or removal of other large mammals, domestic and wild, from the sheep range.

Third. The destruction of ticks themselves by the grazing sheep.

Fourth. The placing of the problem of tick eradication on an industrial basis.

If this can be done, the problem will solve itself and the danger from Rocky Mountain spotted fever, which has hung like a blight over the eastern slopes of the Bitter Root Mountains for 30 years or more, will pass away.